

**EXTENT OF KNOWLEDGE AND ADOPTION OF BIOFERTILIZERS
USE BY THE FARMERS**

By

Mr. Chavan Vishal Shivajirao

(Reg. No:-R/013/110)

A Thesis submitted to the

**MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI – 413 722 DIST. AHMEDNAGAR,
MAHARASHTRA (INDIA)**

In partial fulfilment of the requirements for the degree

Of

MASTER OF SCIENCE (AGRICULTURE)

In

AGRICULTURAL EXTENSION

**DEPARTMENT OF EXTENSION EDUCATION
POST GRADUATE INSTITUTE
MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI - 413722, DIST. AHMEDNAGAR,
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2015

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Approved by

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MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI – 413 722, DIST. AHMEDNAGAR,
MAHARASHTRA (INDIA)
2015**

CANDIDATE'S DECLARATION

I hereby declare that this thesis or a part

There of has not been submitted by

me or any other person to any

other University or Institute

for a Degree or

Diploma

Place : M.P.K.V., Rahuri

Date : / /2015

(Chavan V.S.)

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Maharashtra State (India)

CERTIFICATE

This is to certify that the thesis entitled, “**EXTENT OF KNOWLEDGE AND ADOPTION OF BIOFERTILIZERS USE BY THE FARMERS**”, submitted to the faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL EXTENSION**, is record of a *bonafide* research work carried out by **Mr. Chavan Vishal Shivajirao**, under my guidance and supervision and that no part of the thesis has been submittnd for any other degree or diploma.

The assistance and help received during the course of this investigation and source of literature referred to have been duly acknowledged.

Place : M.P.K.V., Rahuri
Date : / /2015

(G.K. Sasane)
Research Guide

Dr. B. R. Ulmek

Associate Dean,
Post Graduate Institute,
Mahatma Phule Krishi Vidyapeeth,
Rahuri –413 722, Dist. Ahmednagar,
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Place : M.P.K.V., Rahuri

Date : / /2015

(B. R. Ulmek)

Associate Dean

INTRODUCTION

Agriculture production depends on availability and use of quality and quantity of farm inputs. The chemical fertilizer is supposed to be an essential input for boosting up agricultural production. It had played a significant role in increasing agricultural production in the country. However, the continuous use of chemical fertilizers had deteriorated soil fertility, destroyed soil microbial activity and disturbed environmental balance and ecological soundness. The biofertilizers are believed to be the potential alternative to chemical fertilizers in improvement of soil fertility for sustainable crop production. Biofertilizers are assumed to be of great significance as complement or supplement to chemical fertilizers because of significant changes in crop production system, reasonable cost and environmental friendly. They are helpful for proliferation and survival of beneficial micro-organisms in the soil. They are affordable to biofertilizer users because of low cost and economically they are very significant in making available plant nutrients like nitrogen and phosphorous.

Chemical fertilizers play a major role in meeting the nutrients requirement of crop. An F.A.O study indicated that, between 1965 and 1975, fertilizers were responsible for over 50.00 per cent increase in crop production in the developing agriculture and is also true with India. Over a span of five decades, there has been considerable growth with respect to the production and consumption of chemical fertilizers. India is the second largest consumer of fertilisers in the world after China,

consuming about 26.5 million tones by 2020, fertiliser demand in the country is projected to increase to about 41.6 million tones. The consumption of fertilizer over a period has shown increasing trend. During 2011-12, the consumption of fertilizers has increased by 23% as compared to 2006-07. However, during 2012-13, the consumption was down by 8% as compared to previous year. The food grain production during 2012-13 is expected to be about 2553.60 MT, marginally lower than the previous year.

Increasing demand for chemical fertilizers could be met by establishing fertilizer plants. This involves huge investment and is a burden for the economy, since it involves heavy drain on foreign exchange for getting raw materials to the fertilizers plants. In addition, these raw materials are obtained from non-renewable and constantly depleting petroleum based feed stocks. This has led to increase in the price of major inputs like naphtha fuel oil, gas grid power, and coal. For promoting the use of chemical fertilizers, Government had provided subsidy to downscale the sales price of fertilizers. Now, the subsidy has become a burden to the country's exchequer. In recent days, after becoming a member country to the World Trade Organization, Indian government has been directed to reduce the subsidy on chemical fertilizers which has resulted in a sharp increase in prices of fertilizers. This event has created variance in the use of chemical fertilizers in crop husbandry.

It is realized that, chemical fertilizers are playing a critical role in meeting the nutrient requirements of crop. But, the productivity has declined mainly because of low crop fertilizer response over the period. Furthermore, the health of the

soil and environment has degraded because of indiscriminate use of chemical fertilizers and plant protection chemicals. To overcome the problems experienced in the discriminate use of chemical fertilizers, an integrated plant nutrient management practice comprising of using organic manures, green manures and bio fertilizers along with chemical fertilizers needed to be considered.

The constant and sustained efforts of the microbiologists and biotechnologists for isolating and standardizing the activities of microorganisms have helped to increase the production of bio fertilizers. The bio fertilizers are carrier based preparations containing effective strains of microorganisms like bacteria, algae, fungi alone or in combination with sufficient number which can provide plant nutrients through microbial activity. When these microorganisms are incorporated with seeds/seedlings and in soil they ensure enhanced crop production by way of biological nitrogen fixation, solubilisation of fixed phosphate, uptake of phosphorous and other mineral nutrients and synthesis of growth promoting substances. This concept has helped in the development of bio fertilizer industries, as they do not depend on high cost and depleting raw materials. Bio fertilizers are environment friendly, less costly and non-bulky. Total production of bio-fertilizers during 2010 was 24,455.00 m.t. Biofertilizers have been recommended to crops like paddy, wheat, barley, maize, jowar, oat, sugarcane, sugarbeet, tobacco, cotton, potato, brinjal, sunflower, mustard, onion, cauliflower, tomato, cabbage and many other vegetable and fruit crops.

In spite of several beneficial roles imparted by bio fertilizers, their use has so far been limited. Although, biofertilizers have been promoted for the last three decades, there are no systematic studies to know the extent of use of bio-fertilizers and the constraints associated in their use. With this background, a research study entitled "Extent of knowledge and adoption of biofertilizers use by the biofertilizer users" was formulated with the following specific objectives.

1.1 Objectives

1. To study the personal, social and psychological characteristics of the biofertilizer users.
2. To ascertain the knowledge level of biofertilizer users towards the use of biofertilizers.
3. To study the adoption pattern of bio fertilizers by biofertilizer users.
4. To ascertain the factors influencing the use of biofertilizers.
5. To identify the constraints faced and obtain suggestions by the biofertilizer users in adoption of biofertilizers.

1.2 Hypothesis

There exists a relationship between selected personal social profile and situational attributes with extent of knowledge and adoption of biofertilizers use by the biofertilizer users.

1.3 Scope of the study

With the existing scenario, it is felt that a study on knowledge level and adoption level of biofertilizers by the biofertilizer users is the need of the hour. Only after gaining sufficient knowledge on bio-fertilizers, biofertilizer users would develop favorable attitude which will ultimately lead to communicate additional messages on the use of biofertilizers

through various mass media. The finding about the adoption and factors influencing adoption of biofertilizers will throw light on the adoption behaviour of client system. The findings on problems and constraints in the adoption of biofertilizers would help the planners and extension workers to find out the ways to solve them in a systematic manner.

1.4 Limitation of the study

The limitation in respect of conveyance, time and other resources which a student researcher would normally encounter were met with, in this study also. However, care has been taken to make the study objective, definite and systematic as far as possible. Hence, the results of this investigation may be generalized to such of the areas where similar situations prevail.

1.5 Layout of the thesis

The thesis comprises five chapters. The first chapter, Introduction explains the importance and need of the study, objectives, scope and limitations of the study. The second chapter, Review of Literature gives a brief account of relevant studies carried out in the past under different sub-headings. The third chapter, methodology deals with the methods and techniques adopted in conducting the present investigation. The fourth chapter, Results and Discussion contains the results obtained from the research and thoroughly discuss thereupon. The last chapter constitutes Summary, Conclusions and Implications of the study. The literature cited, interview schedule and other related documents are appended at the end of the thesis.

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Above all, I bow my head before the almighty god whose blessing gave me the strength to make this successful venture.

Place: MPKV, Rahuri

(Chavan V.S.)

Date: / /2015

2. REVIEW OF LITERATURE

This chapter deals with the comprehensive review of literature, which is directly or indirectly relevant to the objectives of study. Comprehensive review of literature is an essential part of any scientific investigation, its main functions are to determine the previous work done, assist in delineation of problem area which provide basis of theoretical framework, provide an insight in to methods and procedure to be used.

To enable a lucid reading and comprehension the reviewed literature classified into different subheads and presented with reference to the objectives of the study, in the following subtopics.

- 2.1 Personal, social, and psychological characteristics of the farmers using biofertilizers
- 2.2 Knowledge level of farmers about bio-fertilizers
- 2.3 Adoption level of bio-fertilizers by the farmers
- 2.4 Relationship between personal social and psychological characteristics of farmers and knowledge level of biofertilizers
- 2.5 Relationship between personal social and psychological characteristics of farmers with their adoption of biofertilizers
- 2.6 Constraints faced by the farmers in adoption of biofertilizers
- 2.7 Suggestions given by the farmers using biofertilizers

2.1 Personal, social and psychological characteristics of the respondents

2.1.1 Age

Raut (2006) conducted a study in Nagpur district of Maharashtra and indicated that more than half of the orange

growers (53.33per cent) were middle aged, followed by old (30.00per cent) and young age (16.67per cent) group.

Deshmukh (2007)conducted study in selected districts of Marathwada to know the adoption of fifty four technologies recommended by MAU , Parbhani , the study revealed that majority of the respondents belonged to middle age group (47.22 per cent) followed by young age group (34.72 per cent) and old age group(18.06 per cent).

Singh and Mankar (2007) in their study conducted on mango growers of Ratnagiri district observed that nearly two-third of the farmers were from middle age group (64.55per cent), followed by old (20.00per cent) and young age (15.45per cent) group.

Borhade (2011) Reported that nearly half (48.67 per cent) of the respondents were in middle age group of 36 to 50 years, followed by (38.66 per cent) respondents were observed in the old age group of above 51 years. The percentage of respondents in young age group that is up to 35 years were found to be (12.67 per cent).

Ashok Kumar (2012) showed that highest proportion (49.17per cent) of the vegetable growers were in young age group (<40 years) as compared to 35.83 per cent belonged to middle age group and only 15.00 per cent in old age category. This led to a conclusion that maximum of the young respondents opt for vegetable cultivation which may be due to its better return as compared to other crops.

2.1.2 Education

Palaniswamy and Sriram (2001) conducted a study on scale to measure extension participation of tamarind farmers and revealed that majority of the farmers belonged to medium education level (53.06 per cent). While, 21.77 and 25.17 per cent belonged to low and high education levels, respectively.

Moulasab (2004) in his study on mango growers in North Karnataka indicated that more than 23.00 per cent of growers were educated upto primary school, followed by higher secondary school (19.16 per cent) and 14.16 per cent of the farmers were illiterates.

Deshmukh P.R. (2007) conducted study in selected districts of Marathwada to know the adoption of fifty four technologies recommended by MAU , Parbhani during 1999-2002 , the study revealed that large number of respondents were educated up to higher secondary and above (25.69 percent). Similarly the percentage of secondary education was 24.65 per cent followed by illiterate (17.01 per cent), primary level education (16.66 per cent) and middle standard (15.97 per cent), respectively .

Kadam et al. (2007) Large number of respondents were educated upto higher secondary and above (25.69 per cent). Similarly the percentage of secondary education was 24.65 per cent followed by illiterate (17.01 per cent), primary level education (16.66 per cent) and middle standard (15.97 per cent), respectively.

Walke (2008) revealed that 70 per cent of respondent brinjal growers had received secondary education, 11.60 per cent of them higher secondary education, 7.50 per cent of them

received college education and 7.50 per cent received primary education however 3.34 per cent of respondents were illiterate .

Rajashekhar (2009) conducted a study on analysis of technological gap in papaya cultivation in Bidar and Gulbarga districts of North Karnataka and observed that 25.00 per cent of papaya growers had education upto middle school, followed by 21.67 per cent who were illiterates.

2.1.3 Land Holding

Sidram (2008) conducted a study on analysis of organic farming practices in pigeon pea in Gulbarga district of Karnataka state and revealed that big land holding category occupied the highest percentage (60.83 per cent), while, 23.33 and 15.83 per cent of the farmers were in medium and small land holding categories, respectively.

Mande and Thombre (2009) stated that 34.72 per cent of the sugarcane growers had medium size of land holding.

Sureshkumar (2009) in a study on technological gap in recommended soybean cultivation practices reported that 45.33 per cent of farmers belonged to medium land holding category (10.01-25.00 acres), followed by 22.67 per cent of them belonged to semi-medium land holding category (5.01-10.00 acres), 16.67 per cent of them were small farmers (2.515.00 acres) and 4.66 per cent had large size of holding farmers.

Bahire (2011) found that maximum number (40.83 per cent) of the respondents had semi-medium size of land holding, followed by 20.83 per cent had small size of land holding, 17.50 per cent had medium land holding, 16.66 per cent had marginal land holding and 4.16 per cent had large size of land holding.

Mohanty (2013) reported that 40 percent of respondents were small farmers 30.83 percents of the respondents were medium farmers 22.60 percent respondents were marginal farmers and 6.60 percent respondents' of large farmers .

2.1.4 Cosmopoliteness

Shashidhara (2004) conducted a study on influencing factors and constraints in drip irrigation by horticultural farmers of Bijapur district of Karnataka and found that 41.50 per cent of farmers visited the nearest town occasionally, followed by 37.50 per cent 'once in 15 days'. Whereas, farmers who visited to town for the personal or domestic purpose were 54.10 per cent followed by 35.00 per cent for new technology or agriculture purpose.

Raghavendra (2005) conducted a study on cauliflower growers of Belgaum district of Karnataka and observed that 40.50 per cent of the farmers visited the nearest town 'once in a fortnight', followed by 30.33 and 18.84 per cent who visited the town 'once in a month' and 'once in a week', respectively. Farmers who visited town for personal or domestic purpose were 50.83 per cent, followed by 43.84 per cent visited for want of new technology or information related to agriculture.

Gowda and Gowda (2006) conducted a study in Bijapur and Bangalore Rural districts and observed that more number of Thompson Seedless grape growers had medium (41.00 per cent) and low (43.00 per cent) cosmopoliteness. In case of Bangalore Blue grape growers, majority (62.00 per cent) of them had high cosmopoliteness.

2.1.5 Social Participation

Vijay Kumar (2000) conducted a study on sugarcane growers in Belgaum district of Karnataka and found that 29.00 per cent of the farmers were members of co-operative society and 2.00 per cent were office bearers. Whereas, 8.00 per cent of the farmers were members of youth club and 5.33 per cent of the farmers were members of gram panchayat.

Chandracharan (2003) in a study on Sujala watershed project beneficiary farmers in Dharwad district reported that 4.00 and 2.66 per cent of the farmers were members and office bearers, respectively of gram panchayats whereas 30.00 per cent and 43.33 per cent of farmers attended the meetings regularly and occasionally, respectively.

Jamadar (2012) indicated that most of the sugarcane growers 70.84 per cent had medium social participation. While, 15.83 per cent of the growers had low social participation and 13.33 per cent of them were found in high social participation category.

Tamboli (2012) observed that majority (69.00 per cent) of the farmers had medium social participation while, 16.00 per cent of them had low social participation. Only, 15.00 per cent of farmers were having high level of social participation.

2.1.6 Extension Contact

Patil (2000) observed that 56.67 per cent of the drip adopters had medium extension contact followed by 26.67 per cent of the respondents had high extension contact and 16.66 per cent of the respondents had low extension contact.

Dhamodaran and Vasanthakumar (2001) in their study on adoption of improved sugarcane cultivation practices

revealed that majority of the farmers (52.50 per cent) had low level of extension agency contact, followed by 47.50 per cent of the farmers had medium level of extension agency contact.

Sonwalkar (2002) observed that 82.50 per cent of the respondents had medium extension contact followed by 14.20 per cent of the respondents had low extension contact and only 3.30 per cent of the respondents had high extension contact.

Mandlik (2012) observed that 10.84 per cent of the respondents had low level of extension contact. Whereas, 75.00 per cent respondents had medium level of extension contacts followed by 14.16 per cent of the respondents having high level of extension contact.

Thorat (2013) noticed that majority (59.00 per cent) of the respondents had medium extension contact, 22.00 per cent were having high extension contact, while 19.00 per cent were having low extension contact.

2.1.7 Scientific orientation

Kale (2000) observed that 63.00 per cent of the respondents belonged to medium scientific orientation category followed by 22.00 per cent of them belonged to low scientific orientation category and 15.00 per cent of the drip adopters belonged to high scientific orientation category.

Palaniswamy and Sriram (2001) observed in their study on modernization characteristics of sugarcane growers that 70.75 per cent of farmers belonged to medium level of scientific orientation category, whereas 17.01 and 12.24 per cent of farmers belonged to high and low level of scientific orientation category, respectively.

Patil (2007) found that about 15.00 per cent of the

respondents had low level of scientific orientation. However 61.25 and 23.75 per cent of them had medium and high level of scientific orientation respectively.

2.1.8 Mass Media Utilization

Shashidhara (2003) in his study on drip irrigation farmers in Shimoga and Davanagere districts of Karnataka and reported that 41.11 per cent of the farmers belonged to medium level of mass media participation, followed by low (35.56 per cent) and high level (23.33 per cent) mass media participation.

Sunilkumar (2004) revealed that 59.17 per cent of the farmers were occasionally listening agricultural programmes in radio, whereas, 30.00 per cent of them viewed agricultural programmes in television occasionally. While, 70.83 and 85.00 per cent of the farmers never read the news papers and farm magazines, respectively.

Govinda Gowda and Narayana Gowda (2006) revealed that majority of Thompson Seedless grape growers (55.00 per cent) belonged to medium mass media use category, followed by 33.00 and 12.00 per cent of the farmers who belonged to high and low mass media use categories, respectively.

Gotyal (2007) concluded that more than half of the grape growers (51.00 per cent) had low mass media participation, 39.00 per cent had high and only 10.00 per cent had medium level of mass media participation.

Hinge (2009) reported that higher proportion of the wine grapes growers (38.75 per cent) had medium mass media participation and nearly one third of them (32.50 per cent) belonged to low mass media participation category. Whereas,

28.75 per cent of them belonged to high mass media participation category.

2.2 Knowledge level of farmers about biofertilizers

Chothe *et al.* (2000) conducted a study on constraints faced by farmers in adoption of bio fertilizers and observed that 58.67 per cent of the farmers had medium level of knowledge about bio control practices, followed by 34.67 per cent and 18.66 per cent who had high and low knowledge, respectively.

Borkar *et al.* (2000) conducted a study on characteristics of farmers influencing their knowledge about use of biofertilizers and observed that majority (58.67 per cent) of the farmers had knowledge about the use of biofertilizers to a moderate level followed by 22.67 per cent of them had high level of knowledge and 18.66 per cent of them had low level of knowledge.

Bhople *et al.* (2001) conducted a study on evaluation of KVK under NGO's in Vidharbha region and observed that 74.08 per cent of the respondent had knowledge in respect of neem seed kernel extract, HaNPV spraying (27.54 per cent), trichocards (19.44 per cent) and all bio control practices (23.92 per cent).

Bhople and Borkar (2002) in their study on biofertilizers farmer attitude and adoption observed that majority of the farmers (84.00 per cent) belonged to moderate level of knowledge about different kinds of bio-fertilizers and their associated practices, about one tenth of them were adequately equipped with the knowledge about bio fertilizers and appeared in high knowledge category.

Kharatmol (2006) in his study on impact of trainings conducted on vermicompost by Krishi Vigyan Kendra observed that trained farmers had knowledge about the practices like preparation of vermicompost pit (100.00 per cent), construction of vermicompost pit (50.00 per cent), pit filling (96.67 per cent), sequential filling of pit layer wise (75.00 per cent), watering pit (98.33 per cent) and harvesting practice (95.00 per cent).

Shubhadeep Roy *et al.* (2007) conducted study in Nadia district of West Bengal to measure the level of knowledge and extent of adoption of the recommended gladiolus production practices the study revealed that ,the respondents had proper knowledge about the sowing time and plucking of the flower crop. Regarding the remaining practices they had a moderate level of knowledge.

2.3 Adoption of biofertilizers by the farmers

Wase (2001) in his study on knowledge and adoption of farmers about Jayanti chilli cultivation observed that majority (56.67 per cent) of the farmers belonged to medium level of adoption about jayanti chilli cultivation technology. The percentage of the farmers had high level of adoption was 23.33 per cent and 20.00 per cent of farmers had low level of adoption.

Bhople and Borkar (2002) in their study on biofertilizers farmer attitude and adoption observed that majority of farmers had used recommended quantity of prescribed sticking agents (64.00 per cent), method of drying of inoculated seeds (98.00 per cent) and observed taking complete care during storage of bio fertilizers (54.33 per cent).

Kharatmol (2006) conducted a study on impact of trainings conducted on vermicompost by Krishi Vigyan Kendra,

Bijapur and revealed that high majority of trained farmers had fully adopted the practices of vermicompost like material used for pit construction (100.00 per cent), pit position, material used for filling the pit and harvesting of vermicompost (95.00 per cent), leaving worms to pit, adoption of pit size (90.00 per cent) and meager percentage adopted the practices like pit treatment with chemical (16.67 per cent) and preparation of vermiwash (3.33 per cent).

Dhiraj Kumar Singh *et al.* (2010) conducted study on adoption behavior of commercial vegetable growers , observing that about 85 per cent of the vegetable growers had low or medium adoption of commercial cabbage cultivation practices .

Shashidhara. K. K (2012) in his study conducted on adoption of eco-friendly technologies by cotton growers observed that more than two-third (68.75per cent) of the respondents noticed in medium level of adoption category. Whereas, 16.88 and 14.37 per cent had fallen in high and low level of adoption category of eco-friendly technologies, respectively.

2.4 Relationship between personal , social and psychological characteristics of farmers and knowledge level of biofertilizers

2.4.1 Age and knowledge

Vijayakumar (1997) observed non-significant association between age and knowledge level of farmers.

Bhosale (2003) indicated that there was significant relation between age and knowledge level.

Shubhadeep Roy (2007) observed that there was non significant relationship between age and knowledge of the farmes.

Shakya M.S. (2008) observed non-significant association between age and knowledge level of farmers.

2.4.2 Education and knowledge

Vijayakumar (1997), observed positive and significant relationship education and knowledge level of the farmers.

Bhosale (2003) indicated that there was positive and significant relation between education and knowledge level of farmers.

Shubhadeep Roy (2007) observed there was positive and significant relation between education and knowledge of the farmers.

Suman R. S. (2012) observed significant relationship between education and knowledge of the farmers.

2.4.3. Land holding and knowledge

Raghavendra (1997) observed non significant relationship between land holding of farmers and knowledge.

Ningappa (1998) and srinivasa Reddy (1995) observed significant relationship between land holding and knowledge.

Shubhadeep Roy (2007) observed there was significant relation between land holding and knowledge of the farmers.

Suman R. S. (2012) observed positive and significant relation between land holding and knowledge of the farmers.

2.4.4. Cosmopoliteness and knowledge

Raghavendra (1997) observed negative and significant relationship between cosmopoliteness and knowledge level of farmers

Shakya M.S. (2008) observed positive and significant relationship between cosmopoliteness and knowledge level of farmers

Suman R. S. (2012) observed that the cosmopoliteness was negatively and non-significantly related with the knowledge level of farmers using biofertilizer.

2.4.5. Social participation and knowledge

Vijayakumar (1997) observed there was positive and significant relationship between social participation and knowledge level of farmers.

Tripathi S.K. (2006) observed that the social participation was positively and significantly related with the knowledge level of farmers.

Naik M.H. (2009) observed that social participation was positively and significantly related with knowledge level of organic farming practices .

2.4.6. Extension contact and knowledge

Kantaraj (1980) observed positive and significant relationship between extension contact and knowledge level of farmers

Vasanth Kumar (1999) observed that there was positive and significant relationship between extension contact and knowledge level of farmers

Tripathi S.K.(2006) observed that the extension contact was positively and significantly related with the knowledge level of farmers.

Shubhadeep Roy (2007) observed there was positive and significant relation between extension contact and knowledge of the farmers.

Sarvesh Kumar (2014) observed that there was positive and significant relationship between extension contact and knowledge level of farmers

2.4.7. Scientific orientation and knowledge

Balasubramani (1997).observed that the scientific orientation was positively and significantly related with the knowledge level of farmers.

Tripathi S.K. (2006) observed that the scientific orientation was positively and significantly related with the knowledge level of farmers.

Shakya M.S. (2008) observed that the scientific orientation was positively and significantly related with the knowledge level of farmers.

Suman R. S. (2012) observed that the scientific orientation was negatively and significantly related with the knowledge level of farmers using biofertilizers.

2.4.8. Mass media use and knowledge

Balasubramani (1997) observed that there was a positive and significant relationship between mass media use and knowledge level of farmers.

Raghavendra (1997) observed that there was a positive and significant relationship between mass media use and knowledge level of farmers.

Naik M.H. (2009) observed that there was positive and significant relation between mass media utilization and knowledge level of farmers.

Mooventhon P. (2014) observed that mass media use had positive and significant relationship with the farmers knowledge.

2.5 Relationship between personal and socio-psychological characteristics of farmers and their adoption of biofertilizers

2.5.1. Age and adoption

Vijayakumar (1997) observed that age was negatively and significantly related with the adoption level of respondents.

Bannapure (2007) observed that relationship between age and the level of adoption was negative and significant.

Barse *et al.* (2010) observed that the relationship between the age and adoption level was negative and non significant.

Singh B. K. (2010) observed that the relationship between the age and adoption level was negative and non significant.

Bahire (2011) indicated that relationship between the age and adoption level was negative and significant.

2.5.2 Education and adoption

Sakharkar (1995) observed that there was positive and significant relationship between education and adoption level of farmers.

Bannapure (2007) observed that relationship between education and adoption of level of drip adoption was found to be positively significant.

Barse *et al.* (2010) observed that education shows positive and significant relationship with adoption of drip irrigation system.

2.5.3 Land holding and adoption

Walke (2008) conducted study on technological gap in brinjal cultivation, reported that there exists a positive correlation between size of land holding and level of adoption.

Patil (2010) reported that there was a positive and significant relationship between size of land holding and level of adoption in sericulture management practices.

Kumar et al. (2012) reported that the relationship between size of land holding and adoption level of chickpea growing respondents was positive and statistically significant.

2.5.4. Cosmopoliteness and adoption

Balasubramai (1997) observed that cosmopoliteness of respondents had non-significant relationship with their adoption level of farmers.

Jagannatha Rao (1995) observed that cosmopoliteness of respondents had non-significant relationship with their adoption level of farmers.

Sakya M.S. (2008) observed positive and significant relationship between cosmopoliteness and adoption level of farmers

2.5.5. Social participation and adoption

Jaganatha Rao (1995) observed that observed that there was a positive and significant relationship between social participation and adoption level of the respondents.

Sonwalkar (2002) found that social participation had positive and significant relationship with adoption of drip management practices.

Singh B. K. (2010) observed that there was positive and significant relationship between social participation and adoption.

Barse *et al.* (2010) reported that social participation showed negative and non-significant relationship with adoption of drip irrigation system.

2.5.6. Extension contact and adoption

Shubhadeep Roy (2007) observed that extension contact had positive and significant relationship with the farmers for the adoption of improved practices in gladiolus production.

Singh P. K. (2009) observed that the extension contact was significantly associated with adoption behavior of the farmers

Singh K. V. (2010) observed that extension contact had positive and significant relationship with the farmers for the adoption of improved practices in mango.

Sandeep Chouhan (2013) observed that extension contact had positive and significant relationship with the farmers for the adoption of improved practices in sugarcane.

2.5.7. Scientific orientation and adoption

Ranganatha (1997) observed that Scientific orientation had positive and significant relationship with the adoption of farmers.

Balasubramani (1997) observed that scientific orientation had positive and significant relationship with the adoption of farmers.

Singh P. K. (2008) observed that Scientific orientation had positive and significant relationship with the adoption of farmers.

Singh K. V. (2010) observed that Scientific orientation had positive and significant relationship with the farmers for the adoption of improved practices in mango.

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2.5.8. Mass media use and adoption

Shubhadeep Roy (2007) observed that mass media utilization had positive and significant relationship with the farmers for the adoption of improved practices in gladiolus production.

Singh K.V. (2010) observed that mass media use had positive and significant relationship with the farmers for the adoption of improved practices in mango.

Sandeep Chouhan (2013) observed that mass media use had positive and significant relationship with the farmers for the adoption of improved practices in sugarcane.

Mooventhon P. (2014) observed that mass media use had positive and significant relationship with the farmers adoption level.

2.6 Constraints faced by farmers in adoption of biofertilizers

Marwaha (1995) found that use of bio-fertilizers has not received desired attention. This was mainly because of inadequate awareness among the extension workers and farmers about their utility. Other identified reasons for the non adoption of bio-fertilizers are short shelf life and non availability of bio-fertilizers in time. However, proper education to the extension workers, dealers and farmers about significant and economic feasibility of their application both by seed treatment and soil

application would help in promoting their adoption. This would effectively help the nutrient management in crop husbandry by combining both chemical fertilizers and bio-fertilizers.

Amarnath (1999) in his study on adoption of improved technologies in paddy, sugarcane and groundnut categorized the constraints into institutional, agronomic and social constraints. Institutional constraints included high chemical cost and non availability of input itself. Agronomic constraints included better manual operation and performing particular operation in particular variety like set treatment of sugarcane with bavistin only in seed cane. The social constraints included lack of experience, lack of conviction and non availability of labour.

Chothe and Borkar (2000) in their study on constraints faced by farmers in adoption of biofertilizers observed that lack of knowledge about biofertilizers and low income were the major constraints expressed by the farmers.

Bhople and Borkar (2002) in their study on biofertilizers farmer attitude and adoption observed that constraints encountered by the users of biofertilizers were non availability of bio fertilizers at near by place for use (51.33 per cent).

Gulshan Kumari (2012) in his study conducted on constraints in adoption of IPM practices by rice growing farmers the study revealed that lack of knowledge, lack of skill , non - availabilities of inputs and tools of IPM were major constrains.

M.K.Jangid et al. (2012) conducted study on constraints faced by the organic and conventional farmers in adoption of organic farming practices the major findings were

farmers perceived constraints like inadequate availability of inputs like vermicompost , biofertilizers and organic manures also lack of awareness about concentration , time and method of biofertilizers application.

2.7 Suggestions given by farmers using biofertilizers.

Nagpurkar (1998) observed that the cotton growers suggested that PKV technologies should be demonstrated at research stations, less expensive method could be evolved, the prices of PKV Hy-2 cotton seed should be reduced, technology requiring less labour should be evolved and detailed information and sources of information should be provided to the cotton growers from time to time.

Sagwal (1998) noted that there should be facilities for checking of seed and pesticides (100.00 per cent), providing good quality seed pesticides at reasonable rates (100.00 per cent), high support price (100.00 per cent), credit for purchase of agricultural equipments and other inputs (80.00 per cent) and sale of produce at village level (76.00 per cent).

Gaikwad and Gunjal (2000) noted some suggestions to overcome the problems faced by farmers. More than 50.66 per cent beneficiaries from all KVKs stated that loan should be made available with lower interest rate, and low cost agricultural technologies should be recommended by extension agencies.

Hegde (2001) suggested some measures to overcome the challenges in dairy enterprise as reducing the cost on milk handling, clean milk production, effective animal husbandry extension service should be established to facilitate close dialogue with the farmers and dairy farmers associations should

be established and strengthened to acquire new technologies and understand milk marketing scenario.

Parasu Ram Singh et al. (2004) reported that farmers did not have sufficient knowledge about the nutritive value of concentrate mixture and animals requirements. It suggested that there was an urgent need to educate the farmers about nutritive value of cereal grains, pulse grains and Pashu Ahar and their role for the optimum livestock production.

Kharatmol (2006) suggested the development of community vermicompost pits to obtain sufficient raw material for vermicompost (100.00per cent), procedure to be made simple for availing subsidy schemes (88.33 per cent), interest on loan should be reduced and procedure to be simplified (81.66 per cent) and need more trainings on use of vermiwash (30.00 per cent).

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3. METHODOLOGY

The chapter methodology deals with where and how the study was carried out. For scientific study of any research problem, the researcher has to adopt appropriate materials, methods and procedures in order to arrive at useful conclusions. Keeping this view in mind, this chapter deals with where and how research work was carried out, how to construct the interview schedules, methods used for the selection of the respondents, way adopted for the quantification of qualitative data and preparation of primary and secondary tables. The details of the procedure used in this study are given here as under.

- 3.1 Locale of the study
- 3.2 Sampling procedure
- 3.3 Preparation of interview schedule
- 3.4 Pre testing of interview schedule
- 3.5 Procedure of data collection
- 3.6 Compilation of data
- 3.7 Variables and their empirical measurement
- 3.8 Statistical tools and tests used for analysis of data
- 3.9 Operational definitions and terms used

3.1 Locale of the study

The present study was conducted in Rahuri and Rahata tahsils of Ahmednagar district of Maharashtra state.

3.1.1 Geographical background

Ahmednagar district lies between 19°04'58.96" North latitude and 74°45'09.54" East longitude and Altitude 715.3 m

MSL. Beed district is on the East, Thane and Pune district to the West, Osmanabad district to the South-East, Solapur district to South and Nashik and Aurangabad to the North side of Ahmednagar district.

3.1.2 Area

Ahmednagar district has a geographical area of 17034 sq.kms. comprising of 14 tahsils.

The geographical area of Rahuri tahsil is 1,035.11 km² and Rahata tahsil 759.19 km².

3.1.3 Population

As per 2011 census the total population of Ahmednagar district was 40.87lakh. Out of this 21.06 lakh is male and 19.81 lakh is female population. The total population of Rahuri tahsil is 2.94 lakh, out of this 1.52 lakh male and 1.42 lakh is female, while, the total population of Rahata tahsil is 2.87 lakh, out of this 1.48 lakh male and 1.39 lakh is female. The sex ratio is 956 in Ahmednagar district and 955 in Rahuri and 952 in Rahata tahsils, respectively.

Literacy percentage of Ahmednagar district is 75.82 per cent. The male literacy is 86.90 per cent, while, female literacy is 64.10 per cent.

3.1.4 Topography and soils

3.1.4.1 Soils

The soils of Rahuri and Rahata tahsils are commonly group as light to medium black soil. In very few places black soils are observed. Medium fertile soil are suitable for both *kharif* and *rabi* season crops.

3.1.5 Climate

The climate of this tahsil is generally dry and hot.

3.1.5.1 Temperature

The temperature of this tahsil varies from 9°C (during Dec.) to 41°C (during April and May).

3.1.5.2 Rainfall

Annual average rainfall of Ahmednagar district is 566 mm and that of Rahuri tahsil is 455 mm. and Rahata tahsil is 490 mm.

3.1.6. Land utilization pattern

Table 1. Land utilization pattern of Ahmednagar district, Rahuri and Rahata tehsils.

Sr. No.	Land use category	Ahmednagar (lakh ha.)	Rahuri (lakh ha.)	Rahata (lakh ha.)
1.	Total geographical area	17.02	1.35	0.759
2.	Area under forest	1.63	0.15	0.10
3.	Barren and uncultivated land	1.31	0.13	0.07
4.	Land put on non agriculture use	1.3	0.08	0.04
5.	Cultivable waste	1.9	0.198	0.144
6.	Permanent pasture and grazing land	4.17	NA	NA
7.	Current fallow	0.89	0.37	0.25
8.	Other fallow	0.93	0.64	0.50
9.	Net sown area	10.79	0.33	0.22
10.	Area sown more than once	3.63	0.74	0.52
11.	Gross cropped area	NA	0.20	0.07
12.	Gross cultivable area	11.46	1.34	0.74

Source: Socio-economic survey (Review and district statistical abstract (2012-13).

3.1.7 Cropping pattern

The major crops of Rahuri and Rahata tahsils are sugarcane, maize, wheat, jowar, cotton, soybean, wheat, red

gram, bajara, onion and pomegranate, grape, guava. In *kharif* season major crops grown are sugarcane, cotton, maize, soybean, red gram and bajara, while, in *rabi* season wheat, jowar (*rabi*), are grown. Sugarcane is the major cash crop cultivated on maximum cultivable land in the tahsils annually.

3.1.8. Sources of irrigation

Well is the major source of irrigation in Rahuri and Rahata tahsil which covers large area of these two tahsils. However, canal irrigation is available with limited area.

3.1.9. Livestock

According to the 2002-03 census, the total number of livestock in Rahuri tahsil was 4,61,659 which includes cattle and bullock 1,14,233, buffaloes 10,009, sheep 60,115 and the total size of poultry was 1,15,834. The livestock population in Rahata tahsil was 2,31,546 which includes cattle and bullock 85,215, buffaloes 75,165, sheep 70,165 and total size of poultry 80,830.

3.1.10. Other facilities

The educational facilities are available through primary, secondary schools, technical and non-technical colleges throughout the district. Medical facilities are also available through primary health centers and private practitioners. The credit facilities are available through district co-operative bank, land development bank and State Bank of India. Ahmednagar district is well known for co-operative sector especially co-operative sugar factories.

3.2 Sampling procedure

3.2.1 Selection of tahsil

Rahuri and Rahata tahsils of Ahmednagar district were purposively selected for the study because these tahsils comes under the jurisdiction of Mahatma Phule Krishi Vidyapeeth , rahuri and large amount of biofertilizer are distributed to farmers of these tahsils by university's biofertilizer manufacturing unit.

3.2.2 Selection of villages

Ten villages were selected for study on the basis of list provided by biofertilizer manufacturing unit of Mahatma Phule Krishi Vidyapeeth farmers using biofertilizer.

3.2.3 Selection of respondents

From all 10 villages, 120 respondents were selected by using simple random sampling method for the present study. The details of selected villages and number of respondents from each village are shown as under.

Ahmednagar district



Rahata and Rahuri tehsils



10 villages



120 respondents

Table 2. Selected villages and number of respondents

Sr.No.	Name of villages	No. of respondents
1.	Sade	15
2.	Varvandi	15
3.	Digras	10
4.	Khadambe	10
5.	Pimpri	10
6.	Rahuri Kh.	10
7.	Kolhar	10
8.	Hanumantgaon	20
9.	Devlali	10
10.	Devasandi	10
	Total	120

3.3 Preparation of interview schedule

The structured questionnaire serves as a tool for collection of data. In view of this, questionnaire was prepared on the basis of objectives of the study, which includes relevant questions for seeking information in respect of independent and dependent variables. Efforts were also made to formulate a questionnaire with clear and easy questions. The questions were asked to respondents in both Marathi and English language in order to get accurate response of the respondents.

3.4 Pre testing of interview schedule

The questionnaire was tested prior to its finalization by the researcher. It was pretested by interviewing 10 biofertilizer users who were non-respondents, from the sample area to know whether the respondents provide required information.

After pretesting, necessary improvements were made in the draft schedule and then sufficient copies were made of the refined schedule.

3.5 Procedure of data collection

The researcher personally interviewed the respondents included in the sample. The help of local leaders and progressive farmers were sought for establishing rapport with the biofertilizer user. The farmers were contacted during the time which was convenient to them. This facilitated to obtain free and natural responses from them to the various questions/items included in the schedule. The respondents were assured that the information collected from them will only be used for the research purpose. The replies of the respondents were recorded during the interview. The questionnaire thus filled in was checked before closure of interview for its completion in all respects.

3.6 Compilation of data

The information collected through interview was processed into primary table and then into the secondary tables. The qualitative data were quantified and later the quantified data were converted into frequency, percentages, wherever necessary the scoring was also done. Further the coefficient of correlation was worked out and inferences were drawn.

3.7 Variables and their empirical measurement

The measurement of independent and dependent variables are given below.

A. Independent variables

1. Age
2. Education
3. Land holding
4. Cosmopoliteness
5. Social participation
6. Extension contact
7. Scientific orientation
8. Mass media utilization

B. Dependent variables

1. Knowledge level
2. Adoption level

Measurement of Independent variables

3.7.1. Age

The age has been operationalized as the chronological age of the respondents in completed years at the time of interview. The respondents were categorized in the following categories

Sr. No.	Category	Age range (years)
1	Young	Up to 35
2	Middle	36 to 55
3	Old	56 and above

3.7.2. Education

Education referred to the formal education attained by the biofertilizer users. According to the formal education level of respondent biofertilizer users were classified into different categories as follows:

Sr. No.	Level of education	Category
1.	No education	Illiterate
2.	Upto 4 th standard	Primary
3.	5 th to 10 th standard	Secondary
4.	11 th to 12 th standard	Higher secondary
5.	Above 12 th standard	Graduation and Post Graduation

3.7.3. Land holding :

It refers to the number of hectare land possessed by the farmer

Sr. No.	Category	Land holding
1	Marginal	Up to 1 ha.
2	Small	1.01 to 2 ha.
3	Medium	2.01 to 4 ha.
4	Big	4.01 ha and above

3.7.4. Cosmopoliteness

Cosmopoliteness is the degree to which an individual is oriented outside to his immediate social system.

Each of the respondent was assigned score on the basis of frequency of visits made by the respondent to nearby town . If he frequently or always visited with relating to agriculture then two score was assigned, if he visited sometimes then one score was assigned and if he never visited then zero score was given . By this way respondent could get maximum score up to 10 and minimum 0.

Sr.no.	Frequency of visits	Score assigned
1.	Always	2
2.	Sometimes	1
3.	Never	0

Depending upon total score obtained by each of the respondent, they were grouped into three categories, which were 'low', 'medium' and 'high'. Mean (X) and standard deviation (SD) were used as measure of check

Sr. no.	Category	Scores
1.	Low (<5.31)	Less than score 5
2.	Medium(5.31 to 7.89)	Score between 6 to 7
3.	High(>7.89)	More than score 8

Mean=6.60

S.D.=1.29

3.7.5. Social participation

It is the degree of involvement of the respondents from mere membership to organizational positions and his active participation in the activities of local formal organizations.

Each of the respondent was assigned two score if he was a office bearer of organization and one score was assigned if was member of organization and zero score was given if respondent had no participation in the organization.

Sr.no.	Type of Participation	Score
1.	Office bearer	2
2.	Member	1
3.	No participation	0

On the basis of total score obtained. The respondents were grouped into following three categories by using Mean and Standard Deviation formula.

Sr.No.	Category	Score
1	Low(<2.19)	Up to 2
2	Medium(2.19 to 5.64)	3 to 5
3	High	6 and above

Mean = 3.91

SD =1.72

3.7.6. Extension contact

Extension contact has been operationally defined as the frequency of contact of respondents with extension personnel and extension agencies for seeking information about cultivation practices.

Each of the respondents was assigned score on the basis of frequency of contact made by the respondent. If he frequently or always made contact with extension personal then two score was assigned , if he contacted sometimes then one score was assigned and if he never made contact with extension personals then zero score was given . By this way respondent could get maximum score up to 16 and minimum 0.

Sr.no.	Frequency of contact	Score assigned
1.	Always	2
2.	Sometimes	1
3.	Never	0

On the basis of total score obtained. The respondents were grouped into following three categories by using Mean and Standard Deviation formula.

Sr.No.	Category	Score
1	Low(<3.00)	Up to 3
2	Medium(3.0 to 8.98)	4 to 9
3	High(>8.98)	9 and above

Mean = 5.49

SD = 2.49

3.7.7. Scientific orientation

Scientific orientation is an approach of the respondents towards new farm technology that is being applied in agriculture. It involves usefulness of new technology in advanced agriculture over traditional one. It is defined as the degree to which an individual is inclined to use scientific methods in farming and decision making.

The statements were judged on five point continuum as strongly agree, agree, undecided, disagree and strongly disagree with scores 5, 4, 3, 2 and 1 respectively. This scoring was for positive statements whereas for negative statements it was just reverse. The sum of the total score of statements represents individual's scientific orientation score. The maximum possible score obtained was 30 and minimum was 6. The categorization was done on the basis of Mean and Standard Deviation, as below.

Sr.No.	Category	Score
1	Low scientific orientation	Up to 18
2	Medium scientific orientation	19 to 22
3	High scientific orientation	23 and above

Mean = 20.60

SD= 2.81

3.7.8. Mass media utilization

This variable is operationalized as the exposure of an individual to different mass media channels such as newspaper, farm magazine, radio, television and degree of participation in them.

Mass media Sources of informatio were included in the schedule, which includes personal sources of information, group contact sources of information, mass contact sources of information. The respondents were asked to give response to one of the three alternatives viz., regular, occasionally and never. Score two, one and zero was given to these alternatives, respectively. Then biofertilizer users were grouped into three categories on the basis of Mean and Standard Deviation, as below.

Sr.No.	Category	Score
1	Low(<14.91)	Up to 12
2	Medium(14.9 to 22.95)	13 to 23
3	High(>22.95)	23 and above

Mean = 17.93

SD = 5.02

Measurement of dependent variables

One of the objectives of the study was to assess the knowledge and adoption level of farmers with respect to biofertilizer technology. These variables were measured by following the procedure given below.

3.7.9 Knowledge level of farmers regarding biofertilizer technology

Knowledge refers to information possessed by an individual. It also refers to those behaviors and test situations which emphasize the remembering of some phenomenon or material by an individual either by recognition or by recall of ideas. The knowledge level in the present study has been operationalized as the extent to which an individual possesses understanding and comprehension on various dimensions of biofertilizer technology.

The knowledge test was constructed based on the package of practices and discussion with subject matter specialties, extension personnel of the University.

A list of 12 items was selected for the purpose and each was administered in a question form to the respondents to obtain the response. The questions and answers pertaining to the knowledge test were carefully designed in consultation with members of the advisory committee. The answers to questions were quantified by giving one score to the correct answer and zero score to the incorrect one. As a result, the maximum score that one could get was 12 and the minimum was zero. The total knowledge score for each respondent was calculated by summing up the number of items correctly answered by an individual respondent. After computing knowledge level score,

the respondents were grouped into low, medium and high knowledge categories based on the mean and standard deviation as indicated below.

Sr.No.	Category	Score
1	Low (up to 6.05)	Up to 6
2	Medium (6.06to 10.05)	7 to 10
3	Highn (above 10.05)	11 and above

Mean= 8.05

S.D.=2.0

3.7.10 Adoption level of farmers

Rogers and Shoemaker defined adoption as the decision to make full use of a new idea as the best course of action available.

As in the case of knowledge test, the important biofertilizer recommendations were listed out, finalized and narrowed down to ten practices. These practices were narrated to the respondents one by one, each time enquiring whether that practices had been adopted by them or not.

The scores were assigned for the adoption level of each of the biofertilizer recommendations by farmers in the following way.

Sr. no.	Adoption pattern	Scores
1.	Adopted	2
2.	No adoption	1

The total score for a respondent was obtained by summing up the score obtained on each individual practice. The maximum and minimum scores obtainable by each respondent were 14 and 7, respectively. The respondents were then grouped into low,

medium and high adoption categories based on the mean and standard deviation as indicated below.

Sr.no.	Category	Score
1	Low	Less than (up to 3)
2	Medium	Between (4 to 5)
3	High	More than (6 and above)

Mean=4.1

S.D.=1.30

3.7.11 Constraints

It refers to the problems and difficulties experienced by the farmer in adoption of biofertilizers. The information on constraints experienced by the farmers in adoption of biofertilizers was ascertained by asking questions. The responses about these aspects were recorded and percentage were worked out in order to draw conclusions.

3.7.12 Suggestions

Suggestions were obtained from farmers about the adoption of biofertilizers to overcome the constraints. The suggestions were grouped and percentages of suggestions was worked out.

3.8 Statistical method used :

3.8.1. Frequency and percentage

Frequency and percentage were used of making simple comparisons. The frequency of the particular category was multiplied by hundred and divided by total number of respondents to get percentage.

3.8.2 Mean

The arithmetic mean ($\bar{X}$) is the quotient that results when the sum of all the items in the series is divided by the number (n) of items.

The mean will be calculated by using formula

$$\bar{X} = \frac{\sum X_i}{n}$$

Where,

$\bar{X}$ = Mean,

n = Total number of observation

X_i = Value of observation

3.8.3 Standard Deviation

The standard deviation was obtained by the square root of the average of the square deviation from mean by the following formula:

$$S.D = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n - 1}}$$

Where,

S.D.= Standard deviation,

X_i = Individual score of the i^{th} respondent

$\bar{X}$ = Mean of the sample

n = Total number of respondents

3.8.4 Karl Pearson's coefficients of correlation

To find out the relationship between the selected independent and dependent variable Karl Pearson's coefficient of correlation 'r' use by following formula.

$$r_{xy} = \frac{\sum XY - \frac{\sum X - \sum Y}{N}}{\sqrt{\frac{\sum X^2 - (\sum X)^2}{N} \times \frac{\sum Y^2 - (\sum Y)^2}{N}}}$$

Where,

r = Coefficient of Correlation

X = Value independent variables

Y = Value of dependent variables

N = Number of respondents

3.9 Operational definitions and terms used

1. Age: Age refers to the chronological age of the selected biofertilizers using respondent at the time of interview.

2. Education: Education is a standard of formal schooling possessed by the respondents.

3. Land holding: it refers to number of acres or hectares of land possessed by the farmers.

4. Cosmopoliteness: it refers to the degree to which an individual is oriented outside to his immediate social system.

5. Social participation: Active participation of respondents in various informal organization.

6. Extesion contact : it refers to the frequency of contact of respondents with extension personnel and extension agencies for seeking information about use of biofertilizers.

7. Scientific orientation : this refers to the degree to which a farmer was oriented to the use of scientific methods in farming and discussion making.

8. Mass media utilization : it refers to as an exposure of an individual to different mass media channels and degree of participation in them.

9. Knowledge: The term knowledge refers to the extent of information known and understood by farmer about biofertilizers.

10. Adoption: Adoption is the mental process through which an individual passes from first hearing about an innovation to final adoption of biofertilizers.

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4. RESULTS AND DISCUSSION

This chapter deals with the presentation of the results of investigation and critical discussion of the results presented. The data collected from 120 farmers using biofertilizer from two tahsils of Ahmednagar district, were compiled in to primary tables. Later, they were transferred in to secondary tables in view of the objectives of the study. Appropriate statistical tests were used to analyze the data in order to draw the inferences.

The results of investigation are presented and discussed in this chapter under following heads.

- 4.1 Personal and social and psychological characteristics of the farmers using biofertilizers
- 4.2 Knowledge level of the farmers about use of biofertilizers
- 4.3 Relationship between knowledge and independent variables
- 4.4 Adoption level of the farmers about use of biofertilizers
- 4.5 Relationship between adoption and independent variables
- 4.6 Factors influencing use of biofertilizers by the farmers
- 4.7 Constraints experienced by the farmers in adoption of biofertilizers
- 4.8 Suggestions obtained from the farmers using biofertilizers

4.1. Personal and socio-psychological characteristics of the farmers using biofertilizers :

4.1.1 Age

Age denotes the chronologically completed calendar years by the biofertilizer users. It influences behavior of an individual by exposing to varied situation number of times. Thus, it becomes an essential aspect to consider age of the respondents in this study. The information pertaining to the age of the

biofertilizer using farmers was collected, tabulated and analyzed. The results are presented in Table 3

Table 3. Distribution of the biofertilizer users according to their age

Sr.No.	Age group(Years)	Frequency (n=120)	Percentage
1.	Young (Up to 35years)	40	33.34
2.	Middle (36to55years)	62	51.66
3.	Old(55and above years)	18	15.00
	Total	120	100.00

Table revealed that more than half (51.66 per cent) of the respondents were from middle age group where as 33.34 per cent belonged to young age group and 15.00 per cent respondents belonged to the old age group.

Thus it could be inferred that a majority of biofertilizer using farmers belonged to middle age group which was considered as actively working age groups.

These findings are in line with the findings of Raut(2006) Singh and Manakar (2007)and Borhde(2011).

4.1.2 Education

The level of formal education attained by an individual tends to influence the extent to which they are exposed to new ideas and information. It plays an important role in problem solving capacity of farmers. The information pertaining to the education of the biofertilizer using farmers was collected, tabulated and analyzed. The results are presented in Table 4.

Table 4. Distribution of the biofertilizer users according to their education

Sr. No.	Characteristics Category	Frequency (n=120)	Percentage
1	Illiterate	10	08.33
2	Primary Education (1 st to 4 th Standard)	17	14.16
3	Secondary Education (5 th to 10 th Standard)	47	39.19
4	Higher Secondary Education (11 th to 12 th Standard)	35	29.16
5	Graduation and Post Graduation (Above 12 th Std.)	11	09.16
	Total	120	100.00

The data from Table 2 showed that 39.19 per cent of the respondents were educated up to secondary school level. Whereas 29.16 per cent respondents had educated up to higher secondary, remaining (9.16 per cent) of respondents were educated upto graduation and above level and 14.16 per cent respondents had received primary education and only (8.33 per cent) of respondents were illiterate.

Thus, it concluded that a majority of the farmers had received secondary and higher secondary education. The individuals having higher education are more change oriented, take certain risk, more respective to new idea and have greater knowledge about an innovation. The findings of the present study were in the line with the findings of Thorat *et al.* (2004), wherein they found that 40.00 per cent of the respondent were educated upto secondary education.

4.1.3. Size of land holding

It refers to number of hectare of land owned and operated by the biofertilizer using farmers. It largely determines the socio-economic status of family and source of livelihood. The data of the present investigation in this regard are presented in Table 5.

Table 5. Distribution of the respondents by their size of land holding

Sr. No.	Characteristics Category	Frequency (n=120)	Percentage
1	Marginal(Up to 1 ha.)	12	10.00
2	Small(1.01 to 2 ha.)	36	30.00
3	Medium(2.01 to 4 ha.)	56	46.66
4	Large(4.01 and above)	16	13.34
	Total	120	100.00

The data from the Table 3 reveals that about 46.66 per cent of the farmers had medium size of land holding i.e. 2.01 to 4.00 ha while, 30.00 per cent of the respondents had small size of land holding followed by large size (13.34 per cent) and marginal size (10.00 per cent) of land holding.

Thus, it is seen from the findings that majority of the biofertilizer using farmers had medium size of land holding.

These results are similar to the findings of Gurarv (2000), Sonwalkar (2002) and Bahire (2011).

4.1.4 Cosmopoliteness

Cosmopoliteness is the degree to which an individual is oriented outside to his immediate social system so It influences

behavior of an individual by exposing to varied situation number of times. Thus, it becomes an essential aspect to consider age of the respondents in this study. The data of the present investigation in this regard are presented in Table 6.

Table 6. Distribution of respondents according to their cosmopoliteness

Sr. No.	Category	Frequency (n=120)	Percentage
1	Low (less than 5)	42	35.00
2	Medium (from 6 to 7)	31	25.84
3	High (more than 8)	47	39.16
	Total	120	100.00

Mean= 6.60

SD = 1.29

from above table it can be revealed that (39.16 per cent) of the respondents had high level of cosmopoliteness, while 25.83 per cent of the respondent had medium level of cosmopoliteness and 35.00 per cent of them had low level of cosmopoliteness. This finding is in line with M.S. Shakya (2008) and gowda and gowda (2006)

4.1.5. Social participation

Social participation refers to membership or holding of an official position in any of the formal and informal organization. In view of this the data pertaining to the level of social participation of the respondents were collected, tabulated and analyzed. The respondents were categorized into three groups as per shown in table 7.

Table 7. Distribution of the biofertilizer users by their social participation

Sr. No.	Characteristics Category	Frequency (n=120)	Percentage
1	Low (Up to 2)	35	29.16
2	Medium (3 to 5)	54	45.00
3	High (6and above)	31	25.84
	Total	120	100.00

Mean= 3.91

SD = 1.72

It is elucidated from Table 5 that (45.00 per cent) of the respondents had medium social participation, while 29.16 per cent of the respondent had low social participation and 25.84 per cent of them had high social participation. Similar findings were noticed by Sonwalkar (2002) Jamadar (2012).

The detail data pertaining to the social participation of farmers using biofertilizers were collected, tabulated and analyzed. The results are presented in Table 8.

Table 8. Social participation wise distribution of the biofertilizer users.

Sr. No.	Name of organization	Office bearer	Per cent	Member	Per cent
1.	Co-operative society	2	1.66	6	5.00
2.	Gram Panchayat	3	2.50	9	7.50
3.	Taluka Panchayat	0	0	0	0
4.	Zilla Parishad	0	0	0	0
5.	Dairy society	15	12.50	62	51.66
6.	Self help group	22	18.33	85	70.83
7.	Shetakari vigyan mandal	3	2.50	45	37.50
8.	Bhajani mandal, Mahila mandal etc.	12	10.00	30	25.00

Above table indicates that majority (70.83 per cent) of the biofertilizer users were the members of self help group followed by 51.66 per cent members of the dairy society, . 37.50 per cent was members of shetakari vigyan mandal .It was observed that from the Table that about 18.33 per cent of the biofertilizer users were the office bearer in self help group followed by co-operative milk dairy society (12.50 per cent) and 10.00 per cent are from bhajani mandal mahila mandal etc..

4.1.6 Extension contact

Extension contact gives information about the frequency of contact of respondents with extension personal and extension agencies for seeking information about cultivation practices so it is important to include extension contact in study . The data pertaining to the level of extension contact of the respondents were collected, tabulated and analyzed. The respondents were categorized into three groups as per shown in table 9.

Table 9. Distribution of the biofertilizer users according to their extension contact

Sr. No.	Characteristics category	Frequency (n=120)	Percentage
1.	Low (Score up to 3)	34	28.34
2.	Medium (from 4 to 7)	70	58.33
3.	High (Score 8 and above)	16	13.33
	Total	120	100.00

Mean = 5.49

SD = 2.49

It is elucidated from Table 7. that majority (58.33 per cent) of the respondents had medium level of extension contact, while

28.34 per cent of the respondent had low level of extension contact and 13.33 per cent of them had high extension contact.

This finding is in line with Thorat(2013)

The detail data pertaining to the extension contact of farmers using biofertilizers were collected, tabulated and analyzed. The results are presented in Table 10.

Table 10. Extension contact wise distribution of the biofertilizer users.

Sr. No.	Extension workers	Frequency (n=120)		
		Always	Sometimes	Never
1.	Agril. Assistant	44(36.66)	32(26.66)	44(36.66)
2.	Assistant agril. Officer	29(24.16)	17(14.16)	74(61.66)
3.	Assistant Horticulture officer	29(24.16)	25(20.83)	66(55.00)
4.	Agril. Univ. Scientist	21(17.50)	30(25.00)	69(57.50)
5.	Krishi vigyan Kendra	23(19.16)	29(24.16)	68(56.66)
6.	Input dealers	102(85.00)	12(10.00)	6(5.00)
7.	Extension personnel of private companies	44(36.66)	40(33.33)	36(30.00)
8.	Others (if any),specify.	31(25.83)	55(45.83)	34(28.33)

From the above table it can be seen that majority of farmers (85.00 per cent) always contacted with input dealers for seeking agricultural information followed by Agricultural Assistants (36.66 per cent). Above table also indicates that (61.66) per cent of the respondents never had contacted with

Assistant Agricultural officer followed by (57.50) per cent of farmers had never contacted agricultural university scientists.

4.1.7 Scientific Orientation

This refers to the degree to which a farmer was oriented to the use of scientific methods in farming and decision making . The information regarding the scientific orientation of the biofertilizer users was collected and is presented in the Table 11.

Table 11. Distribution of biofertilizer users according to their scientific orientation

Sr. No.	Category	Frequency (n=120)	Percentage
1	Low (Score up to 17.80)	32	26.66
2	Medium (Score 17.80 to 23.40)	40	33.34
3	High (Score 23.40 and above)	48	40.00
	Total	120	100.00

Mean = 20.60

SD= 2.8

The data from the Table 9 and Figure showed that 40.00 per cent of the respondents had high level of scientific orientation. However, 33.34 and 26.66 per cent of them had medium and low level of scientific orientation respectively. This clearly shows that a large proportion of the biofertilizer users had high level of scientific orientation.

This finding is in agreement with with Kale (2000) and Patil (2007).

4.1.8 Mass media utilization

It indicates the exposure of an individual to different mass media channels and degree of participation in them so the data pertaining to the level of mass media utilization of the respondents were collected, tabulated and analyzed. The respondents were categorized into three groups as per shown in table 12.

Table 12. Distribution of respondents according to their mass media utilization

Sr. No.	Category	Frequency (N=120)	Percentage
1	Low (Score up to 14.91)	33	27.50
2	Medium (Score 14.91 to 22.95)	62	51.66
3	High (Score 22.95 and above)	25	20.84
	Total	120	100.00

Mean = 7.93

SD= 3.02

The data from the Table 10 showed that 51.66 per cent of the respondents had medium level of mass media utilization. However, 20.84 and 27.50 per cent of them high and low level of mass media utilization respectively.

This finding is in line with Shashidharan (2003) and Hinge (2009)

The detail data pertaining to the various mass medias used by farmers using biofertilizers were collected, tabulated and analyzed. The results are presented in Table-13.

Table 13 . Mass mediawise distribution of the biofertilizer users.

Sr.no.	Items	Extent of Utilization		
		Regularly	Occasionally	Never
	A)Print Media			
1.	News papers	97(80.83)	14(11.67)	9(7.50)
2.	farm .Magazines	77(64.17)	27(22.50)	16(13.33)
3.	University publication	12(10.00)	28(23.33)	80(66.67)
	B)Electronic Media			
1.	Radio	12(10.00)	28(23.33)	80(66.66)
2.	T.V.	98(81.66)	15(12.50)	7(5.83)
3.	Mobile	22(18.33)	32(26.66)	66(55.00)
4.	Internet	5(4.16)	12(10.00)	103(85.33)

A) Print Media

It could be seen from the above table majority of respondents 80.83 per cent used news papers as a source of information followed by (64.17 per cent) respondents use farm magazines as an media for seeking agricultural information whereas 10.00 per cent had used university publication.

B) Electronic Media

It could be also seen from the table that majorityof the respondents used television (81.66 per cent) followed by mobile phones (18.33 per cent) as media for seeking agricultural information.

4.2. knowledge level of farmers about the use of biofertilizers.

4.2.1 Overall knowledge level of farmers about biofertilizers.

The concept 'Knowledge' in the present investigation was operationalised as functional understanding of the respondents or the body of information possessed by the respondents about the use of biofertilizer. The knowledge score of each respondent farmer was calculated and converted into percentage. The respondent farmers were classified into three categories viz., a) low knowledge level, b) medium knowledge level and c) high knowledge level. The results are presented in table no. 14

Table 14. Distribution of the respondents according to their level of overall knowledge of farmers about biofertilizers

Sr.no.	Category	Frequency	Percentage
1.	Low (up to 6)	36	30.00
2.	Medium (7 to 10)	49	40.84
3.	High (11 and above)	35	29.16

Mean = 8.05

SD = 2.0

A close examination of Table 12 indicates that a considerable percentage (40.84 per cent) of respondents belong to medium level of knowledge, whereas (30.00 per cent) and (29.16 per cent) of respondents of biofertilizer users were in low and high level of knowledge, respectively. The possible reasons for some of the respondents to be in low level of knowledge category is that some aspects of biofertilizer technology involved difficult technical aspects which might have come in the way of acquiring

needed information. This was also due to difference in personal attributes of the respondents.

This finding is in conformity of Chothe (2000)

4.2.2 Knowledge of farmers about specific aspects of biofertilizer usage

Table 15. Knowledge of farmers about specific aspects of biofertilizer usage

Sr. No.	Specific knowledge about biofertilizer usage		Knowledge level	
			Frequency	per cent
1	Type of the biofertilizer used	Rhizobium	70	58.33
		<i>Azospirillum</i>	57	47.50
		PSB	75	62.50
		Azotobactor	42	35.00
		Others	15	12.50
2	Source of availability	Agricultural	59	49.16
		University		
		Fertilizer shop	77	64.16
		Others	19	15.83
3	Method of application	Seed treatment	68	56.66
		Seedling dipping	47	39.16
		Broadcasting	58	48.33
		Split application	63	52.50
4	Quantity required for one hectare	1 kg	61	50.83
		10 kg	69	57.50
		500 gm	63	52.50
5	Time of application	Before sowing	83	69.16
		After sowing	78	65.00
6	Time gap with in which the treated seeds to be sown		108	90.00
7	Using biofertilizer without mixing with chemical fertilizer		105	87.50
8	Using biofertilizer before expiry date		96	80.00
9	Nutrient supplied by the biofertilizers	Nitrogen	70	58.33
		Phosphorus	50	41.66
		Both	73	60.83

10	Quantity available in packets	250 gm	27	22.50
		500 gm	29	24.16
		1 kg	10	8.33
11	Cost of biofertilizers	Rs. 50/kg	26	21.66
		Rs. 70/kg	28	23.33
		Rs. 50/kg	24	20.00
12	Advantage of biofertilizers usage		96	80.00

A perusal of results in above Table indicates that majority of respondents had correct knowledge on type of bio fertilizer used PSB (62.50 per cent), Rhizobium (58.33 per cent), Azospirillum (47.50 per cent), Azatobactor (35.00 per cent) Less number of the respondents were aware of name of the biofertilizer used. This may be due to the technical name of the biofertilizers. The words, Rhizobium and Azospirillum are difficult to pronounce by respondents. source of availability of biofertilizers from fertilizer shop (64.16 per cent), agricultural university (49.16 per cent), An appraisal of above Table indicates that majority of the respondents had correct knowledge about the source of availability. This is due to the fact that Department of Agriculture is the major organization promoting biofertilizer technology among farmers through different schemes. method of application seed treatment (56.66 per cent), Broadcasting (48.33 per cent), seedling dipping (39.16 per cent), quantity required for one hectare one kilogram (50.83 per cent), time of application before sowing (69.16 per cent), nutrient supplied by bio fertilizer nitrogen (58.33 per cent), phosphorous (41.66 per cent), using bio fertilizer without mixing with chemical fertilizer (87.50 per cent), using bio fertilizer before expiry date (80.00 per cent), and advantage of bio fertilizer usage (80.00 per cent) . A meager number of them were not aware of quantity available in packets

(24.16 per cent), cost of bio fertilizer (23.33 per cent) and time gap within which the treated seeds to be sown (43.33 per cent).

A meager number of the respondents had correct knowledge about quantity of biofertilizer required for one hectare crop and nutrients supplied by the biofertilizer. This may be due to poor grasping power of the farmers on application of biofertilizer. In addition easy taking tendency of respondents about the "principles knowledge" has yielded this result. Majority of the respondents had knowledge about cost of biofertilizer, impact of biofertilizer use and quantity of biofertilizer available in packets.

4.3 Relationship between knowledge and personal, social and psychological characteristics of farmers

Table 16 .Relationship between knowledge and personal, social and psychological characteristics of farmers

Sr. No.	Characteristics	Correlation coefficient (r)
1	Age	-0.143NS
2	Education	0.178*
3	Land holding	0.110NS
4	Cosmopolitaness	-0.179*
5	Social participation	0.191*
6	Extension contact	0.209*
7	Scientific orientation	0.178*
8	Mass media use	0.192*

NS=Non significant

**=Significant at 1 per cent level

=Significant at 5 per cent level

The characteristics namely age, education, social participation, extension contact, scientific orientation and mass media use had positive and significant relationship with their knowledge level. However, other characteristics namely, land holding had non significant association with the knowledge level of farmers. While cosmopolitaness hd negative but significant relationship .

4.3.1 Age and knowledge

There was negative and non significant relationship between age and knowledge level of farmers. The probable reason for this finding was that, the young farmers were more receptive to new ideas and they make efforts to gain higher knowledge to put them into practice. The older farmers because of their low retention and retrievable capacities of acquired information might have possessed less knowledge on biofertilizer technology.

This finding is in conformity with findings of Vijaya Kumar (1997) he observed non-significant association between age and knowledge level of farmers. Thus the present findings suggest that the extension workers to reach large number of people in a short time should first tackle young people who are receptive to new ideas and then concentrate on old people who take more time to change.

4.3.2 Education and knowledge

Education was positively and significantly related with the knowledge level of farmers. Educated farmers will have better opportunity to acquire more scientific information by way of mass media contact, exposure to print media, interaction with scientists and extension workers to get clarification on various scientific aspects of biofertilizer usage.

The present finding is in line with the findings of bhosale (2003) Roy (2007) and Singh K.V. (2010) This suggests that formal education is instrumental in enhancing the knowledge of the farmers on biofertilizer technology. Extension workers can take a clue from this finding.

4.3.3 Land holding and knowledge

The relationship between land holding of farmers and their knowledge level was non-significant. Since biofertilizer is a cheaper and eco-friendly technology, land holding is not a criterion to know about improved practices. Profitability of raising a crop makes farmers know about improved technology irrespective of the size of farm. This finding is in conformity with that of Raghavendra (1997).

Hence there is no need for extension workers to stratify farmers irrespective of their farm size are interested to know about new technology.

4.3.4 Cosmopoliteness and knowledge

There was negative and significant relationship between cosmopoliteness and knowledge level of farmers. The possible reason could be that cosmopolite individuals will have greater contact with the society and this might have broadened

their mental horizons, thereby motivating the respondents to try new technology.

This finding supported by the findings of Raghavendra (1997)

4.3.5 Social participation and knowledge

There was positive and significant relationship between social participation and knowledge level of farmers. This may be due to the fact that interaction with office bearers of many organizations have increased the knowledge of respondents. Also, it is possible that more frequency information helped them to share ideas and information among themselves.

This finding is in agreement with the findings of Badodiya S.K. (2011) Vijaykumar(1997),Tripathi (2006).

Thus, it is clear that more the social participation more will be the knowledge. It is therefore suggested that extension agencies work towards organizing co-operatives, youth club and farmers organizations to facilitate effective interaction among themselves.

4.3.6 Extension contact and knowledge

There was positive and significant relationship between extension contact and knowledge level of farmers. The farmers contacted the extension personnel of different departments. This might have helped them to gain more knowledge on the biofertilizer usage. This finding is supported by the findings of Vasantha Kumar (1999) Tripathi (2006) nd Roy (2007).

4.3.7 Scientific orientation and knowledge

The scientific orientation was positively and significantly related with the knowledge level of farmers. The possible reason could be that the respondents with higher scientific orientation would try to gather more information which could be applied to the field for increasing production.

Similar findings were reported by Sandeep Chouhan (2013)

4.3.8 Mass media use and knowledge

There was a positive and significant relationship between mass media use and knowledge level of farmers. The reason for this could be that regular flow of technical information through print media such as leaflets and folders published by the Department of Agriculture and other organizations to promote biofertilizer technology. Such technical information might have increased the knowledge level of farmers.

This finding is in conformity with the findings of Singh K. V. (2010). This implies that the extension workers can make effective use of the mass media to put up scientific information to the farmers.

4.4 Adoption level of biofertilizer by the farmers

4.4.1 Overall adoption level of biofertilizer by the farmers

In order to get an overall picture of adoption of biofertilizer by the respondents, the adoption score was calculated. For measuring the adoption level of biofertilizer users, list of specific practices of biofertilizer users was used. Then, the respondents

were classified in to three groups on the basis of Mean $\pm$ Standard Deviation as below.

Table17. Distribution of the respondents according to their level of overall adoption

Category	Frequency	Percentage
Low (up to 3)	63	52.50
Medium (4 to 5)	45	37.50
High (more than 6)	12	10.00
Mean=4.1		SD=1.30

A close examination of Table indicates that a considerable percentage (37.50 per cent) of respondents belonged to medium level of adoption, whereas 52.50 per cent and 10.00 per cent of biofertilizer users were in the low and high level categories of adoption, respectively.

This finding is in conformity of Bhosale (2003)

4.4.2 Adoption of specific biofertilizer practices by the farmers

Table18. Adoption of specific biofertilizer practices by the farmers

Sr. No.	Adoption of specific practices of biofertilizers		Adoption level	
			Frequency	Per cent
		Rhizobium	40	33.33
		Azospirillum	23	19.16

1	Type of biofertilizer used	PSB	39	32.50
		Azotobactor	22	18.33
		Others	5	4.16
2	Quantity of biofertilizers used for one hectare	200-400 gm	23	19.16
		1 kg	27	22.50
		25 kg	31	25.83
3	Time of application	Before sowing	41	34.16
		After sowing	38	31.66
4	Using biofertilizer without mixing with chemical fertilizers		47	39.16
5	Using biofertilizers before expiry date		39	32.50
6	Method of application	Seed treatment	34	28.83
		Seedling dipping	23	19.16
		Broadcasting	41	34.31
		split application	31	25.83
7	Percent of yield increased by using biofertilizer	10 %	45	37.50
		15 %	39	32.50

An observation of Table shows that more number of the respondents had adopted practices namely, type of bio fertilizer

(33.33 per cent), quantity of bio fertilizer used for one hectare (25.83per cent), time of application (34.16per cent), method of application (34.31per cent), per cent of yield increased by using bio fertilizer (37.59per cent), using bio fertilizer before expiry date (32.50per cent) and using bio fertilizer without mixing with chemical fertilizer (39.16per cent). Thus, the results indicates that there was considerable variation in the extent of adoption of specific biofertilizer practices by the farmers.

The reasons behind this variation in adoption of biofertilizer is that all improved practices cannot be adopted by all growers simultaneously. The adoption of farm practices or farm innovations as complex process which needs mental thinking, capacity to implement, responsibility as well as risk bearing ability. Further, some practices are influenced by the factors like relatively low cost, compatibility and local availability. In addition to these agro-climatic factors, personal and socio-psychological factors also play a major role in the adoption of agricultural innovation

4.5 Relationship between adoption and independent variables

Table 19. Relationship between adoption and independent variables

Sr. No.	Characteristics	Correlation coefficient (r)
1	Age	-0.189*
2	Education	0.228*
3	Land holding	-0.051NS
4	Cosmopoliteness	0.262**
5	Social participation	0.258**
6	Extension contact	0.301**
7	Scientific orientation	0.261**
8	Mass media use	0.328**

NS=Non significant

**=Significant at 1 per cent level

*=Significant at 5 per cent level

An appraisal of Table indicates that characteristics namely education, cosmopoliteness, social participation, extension contact, scientific orientation, and mass media use of respondents had positive and significant relationship with their adoption level. However, other characteristics namely land holding had non-significant relationship with the adoption level. Age had negative but significant relationship with their adoption level.

4.5.1 Age and adoption

Age was negatively and significantly related with the adoption level of respondents. This may be due to the fact that the young farmers were more receptive to new ideas and tried most of the new technologies. Therefore, it is suggested that Department of Agriculture may take confidence of older farmers, also to bring about greater adoption level of biofertilizer technology.

This finding shows conformity with the findings of Nadre and Dhakane (2003).

4.5.2 Education and adoption

There was positive and significant relationship between education and adoption level of farmers. The possible reason could be that educated farmers will have a better opportunity to acquire more scientific information by way of exposure to mass media, printed material, interaction with scientists and extension worker to know about biofertilizer technology. Their knowledge level was also more. This might have promoted them to adopt biofertilizer technology.

This finding shows conformity with the findings of Wane (2000).

4.5.3 Land holding and adoption

There was a non-significant relationship between land holding and adoption level of the farmers. Since land holding was not related to knowledge, it has not lead to adoption. Hence the result is quite obvious.

The findings by Sakharkar (1995)

4.5.4 Cosmopoliteness and adoption

Cosmopoliteness of respondents had positive and significant relationship with their adoption level of farmers. Contact with different extension agents provides them enough knowledge about the technology which in turn motivates them to adopt.

Finding of this study is in conformity with the findings of Shakya M. S. (2008).

4.5.5 Social participation and adoption

There was a positive and significant relationship between social participation and adoption level of the respondents. Respondents who were members might have got the technical information on the usage of biofertilizers.

This fact might have influenced the adoption level of respondents to a large extent.

Finding of this study is in agreement with the findings reported by Gautam U. S. (2007). Rao (1995) .

4.5.6 Extension contact and adoption

The extension contact was significantly associated with adoption behaviour of the farmers. It is obvious that constant contact with Agricultural Assistant, A.O provides necessary and timely guidance and reinforcement to the farmers and motivate them to initiate action. It is expected that respondents contact with officials can naturally influence adoption behaviour to a large extent their.

This finding is in line with the findings of Tiwari (2007) S. G. and Balasubramani (1997).

4.5.7 Scientific orientation and adoption

Scientific orientation had positive and significant relationship with the adoption of farmers. To manage farms, efficiently farmers should be highly scientific oriented. Scientific and economic operations will bring them success for their efforts.

Similar results were also observed in the present study and this finding are in conformity with Tiwari (2007) Raghavendra (1997) and Chauhan (2013).

4.5.8 Mass media use and adoption

There was positive and significant relationship between mass media uses and adoption level of the farmers. Now days, mass media carry more information on biofertilizer technology. It is likely that farmers were adequately exposed to mass media and were motivated to adopt the technology. Hence, the positive relationship was observed.

This finding is supported by that of Sarvesh Kumar(2014)

4.6 Factors influencing the use of biofertilizers by farmer

Table20. Factors influencing the use of biofertilizers by respondents

Sr.No	Factors	Frequency	Percentage
1	High yield	98	81.66
2	Regularly supply	94	78.33
3	Easy to procure	85	70.83
4	Low price	77	64.16
5	Enhances soil fertility	54	45.00
6	Eco friendly	30	25.00

It could be seen the Table that factors influencing respondents for use of fertilizers increase in yield (81.66 per cent), followed by others factors which are regular supply (78.33 per cent), easy to procure (70.83 per cent), low price (64.16 per cent), enhance in soil fertility (45.00 per cent) and eco friendly (25.00 per cent).

The possible reason for above findings may be increase in the yield over previous years after using biofertilizers and another reason is increasing awareness among the farmers.

4.7 Constraints encountered in the adoption of biofertilizer practices by the farmers

Table21. Constraints encountered in the adoption of biofertilizer practices by the farmers

Sr. No.	Constraints	Frequency	Percentage
1	Lack of reinforcement efforts from the	102	85.00
2	departmentInability to understand the details of biofertilizers	93	77.50
3	Lack of finance	84	70.00
4	Non availability of biofertilizer locally at times when needed	81	67.50
5	Lack of knowledge about practices	65	54.16
6	Non-availability of extension literature on biofertilizer usage	50	41.66
7	Improper soil condition	20	16.66
8	Low shelf life of biofertilizer	6	5.00

It is revealed by the respondents in Table that majority of the respondents expressed that lack of reinforcement efforts from the department (85.00per cent) was the major constraint encountered in the adoption of biofertilizer technology. Though the Department of Agriculture and other organizations publish booklets, leaflets and folders on improved package of practices, specific extension literature on biofertilizer use is very much limited. The necessity of such literature solely on biofertilizer is truly reflected in the form of constraints encountered by the farmers. Hence, it is suggested that the Department of Agriculture and other concerned agencies to publish specific extension literature and concerned demonstrations on biofertilizer use.

The other important constraints encountered by the farmers were lack of extension literature on bio fertilizers usage, lack of finance, non-availability of biofertilizer locally at time when needed and improper soil condition. These results are obvious due to the following reasons.

1. Agricultural Assistant provides guidelines while giving/selling biofertilizer to farmers. His participation and guidance seems to be very much limited at the field level.
2. Some private companies arrange to sell bio-fertilizer in large quantities with higher prices which may not be within reach of farmers.
3. Due to the Government policy, bio-fertilizers might have been stocked only in villages having cooperative societies. This might have come in the way of other neighboring village farmers to have accessibility to the biofertilizers. Added to this, biofertilizers available with the private agency are costly.

Stocking of biofertilizer also sometimes gets delayed when the season is almost coming to an end.

4. Improper soil conditions like waterlogged soils, dry areas and problematic soils might have hindered the adoption of biofertilizer technology which is truly reflected in the form of constraints.

Low shelf life and non-availability of specific strains of biofertilizer and inability to understand the details were also expressed as constraints by some farmers.

4.8 Suggestions by the farmers for adoption of bio fertilizer

Table 22. Suggestions by the farmers for adoption of bio fertilizer

Sr. No	Suggestions	Frequency	Percentage
1.	Bio fertilizers usage can be increased if they are provided free of cost	103	85.83
2.	Availability of bio fertilizers in villages	92	76.66
3.	Subsidy on bio fertilizers	86	71.66
4.	Technical aspects on biofertilizer should be provided by extension agencies	30	25.00
5.	Awareness campaign on popularization of biofertilizers	15	12.50

Suggestions offered by the farmers in adoption of bio fertilizer were analysed and presented in Table. Majority of the respondents expressed that bio fertilizer usage can be increased if they are provided free of cost was the major suggestion offered

by the farmers to adopt bio fertilizer technology. The other suggestions were availability of bio fertilizers in villages (76.66per cent), subsidy for bio fertilizers (71.66per cent).

The reason may be due to cost of bio fertilizers may not meet out by the farmers and another reason for low usage of bio fertilizers was non availability of the bio fertilizer in time in villages. Non-availability of extension literature on bio fertilizers usage (41.66per cent), improper soil condition (16.66per cent) and low shelf life of bio fertilizers (5per cent) were also expressed as constraints by some respondents

On above findings this can be conclude like training for the farmers on bio fertilizers usage should be give more and also awareness programmes can be conducted.

5. SUMMARY, CONCLUSIONS AND IMPLICATIONS

This chapter includes summary, conclusions and implications for further research and action. A brief summary of this research includes the conclusions drawn on the basis of analysis and interpretation of data. This is followed by the implications for further action, particularly for solving the problems.

Plant nutrients are important components of crop production. The quantum jump desired to achieve the mounting demands for food in our country requires rationalizing the nutrient application for different crops, particularly paddy and other pulse crops. Efforts have to be made to harvest the benefit of positive interaction among the different biofertilizers.

Several research studies have revealed that there was a wide variation among farmers in the adoption of package of practices in particular. This study was taken up to analyses the two main dimensions namely the knowledge and adoption level of farmers about biofertilizers and the personal and socio-psychological characteristics influencing them. Therefore, the present study was formulated to assess these aspects in detail with the following specific objectives.

1. To study the personal , social and psychological characteristics of the farmers.
2. To ascertain the knowledge level of farmers towards use of biofertilizers
3. To study the adoption pattern of biofertilizers by biofertilizer users
4. To ascertain the factors influencing the use of biofertilizers

5. To identify the constraints faced and obtain suggestions by the farmers in adoption of biofertilizers

The present study was conducted in Rahuri and Rahata tahsils of Ahmednagar district. The findings of this study are based on the data collected by interviewing 120 respondents from 10 villages of two tahsil in Ahmednagar district.

There were two dependent variables namely "knowledge" and "adoption". There were 8 independent variables viz., 1) Age, 2) Education, 3) Land holding, 4) Cosmopoliteness, 5) Social participation, 6) Extension contact, 7) Scientific orientation, and 8) Mass media use. Apart from this, constraints encountered in the adoption of biofertilizers and suggestions for use of bio fertilizers by the farmers were also studied.

To measure these dependent and independent variables, appropriate scientific tools were used in the study. The data was collected from the respondents through interview schedule by personal interview technique. They were analysed by using percentage and simple correlation.

5.1 Summary

5.1.1 Profile of Biofertilizer users

The study revealed that majority (51.66 per cent) of the respondents belonged to the middle age group, while 33.34 and 15.00 per cent of them belonged to young and old age group, respectively.

Less than half (39.19 per cent) of the respondents had secondary education followed by 29.16 per cent of higher secondary education. Whereas, 14.16 per cent respondents had primary level of education and 9.16 per cent respondents had graduation level education. Only 8.33 per cent were illiterate.

About 46.66 per cent of the farmers had medium size of land holding i.e. 2.01 to 4.00 ha while, 30.00 per cent of the respondents had small size of land holding followed by large size (13.34 per cent) and marginal size (10.00 per cent) of land holding.

Majority (39.16 per cent) of the respondents had high level of cosmopoliteness, while 25.84 per cent of the respondent had medium level of cosmopoliteness and 35.00 per cent of them had low level of cosmopoliteness.

About (45.00 per cent) of the respondents had medium social participation, while 29.16 per cent of the respondent had low social participation and 25.84 per cent of them had high social participation.

Majority (58.33 per cent) of the respondents had medium level of extension contact, while 28.34 per cent of the respondent had low level of extension contact and 13.34 per cent of them had high extension contact.

About 40.00 per cent of the respondents had high level of scientific orientation. However, 33.33 and 26.66 per cent of them had medium and low level of scientific orientation respectively.

Most of the respondents 51.66 per cent of had medium level of mass media utilization. However, 20.84 and 27.50 per cent of them high and low level of mass media utilization respectively.

5.1.2 Knowledge of the respondents about biofertilizers

A considerable percentage (40.84 per cent)of respondents belong to medium level of knowledge , whereas (30.00 per cent) and (29.16 per cent) of respondents of

biofertilizer users were in low and high level of knowledge, respectively.

Knowledge of the respondents about sprcific practices of biofertilizer

In case of knowledge of respondents about specific practices of biofertilizer the study reveal that majority of respondents had correct knowledge on type of bio fertilizer used PSB (62.50 per cent),Rhizobium (58.33 per cent),Azospirillum (47.50 per cent),Azatobactor (35.00 per cent).source of availability of biofertilizers from fertilizer shop (64.16 per cent),agricultural university (49.16 per cent). In case of method of application seed treatment (56.66 per cent),Broadcasting (48.33 per cent),seedling dipping (39.16 per cent), quantity required of biofertilizers for seeds sown in one hectare one kilogram (50.83 per cent), time of application before sowing (69.16 per cent), nutrient supplied by bio fertilizer nitrogen (58.33 per cent), phosphorous (41.66 per cent), using bio fertilizer without mixing with chemical fertilizer (87.50 per cent), using bio fertilizer before expiry date (80.00 per cent), and advantage of bio fertilizer usage (80.00 per cent) . A meager number of them were not aware of quantity available in packets (24.16 per cent), cost of bio fertilizer (23.33 per cent) and time gap within which the treated seeds to be sown (90.00 per cent).

5.1.3 Adoption of biofertilizers by the farmers

Present study indicates that a considerable percentage (37.50 per cent) of respondents belonged to medium level of adoption, whereas 52.50 per cent and 10.00 per cent of biofertilizer users were in the low and high level categories of adoption, respectively.

Adoption of specific biofertilizer practices by the respondents

In case of adoption of specific practices more number of the respondents had adopted practices namely, type of bio fertilizer (33.33 per cent), quantity of bio fertilizer used for one hectare (25.83 per cent), time of application (34.16 per cent), method of application (34.31 per cent), per cent of yield increased by using bio fertilizer (37.59 per cent), using bio fertilizer before expiry date (32.50 per cent) and using bio fertilizer without mixing with chemical fertilizer (39.16 per cent). Thus, the result indicates that there was considerable variation in the extent of adoption of specific biofertilizer practices by the farmers.

5.1.4 Relationship of independent variables of biofertilizer users with their level of knowledge and adoption

The characteristics namely age, education, social participation, extension contact, scientific orientation and mass media use had significant relationship with their knowledge level. However, other characteristics namely, land holding had non significant association with the knowledge level of farmers

In case of adoption study indicates that characteristics namely age, education, cosmopolitaness, social participation, extension contact, scientific orientation, and mass media use of respondents had positive and significant relationship with their adoption level. However, other characteristics namely land holding and had non-significant relationship with the adoption level.

5.1.5 Constraints encountered in the adoption of biofertilizer practices by the farmers

Majority of the respondents expressed that lack of reinforcement efforts from the department (85.00per cent) was the major constraint encountered in the adoption of biofertilizer technology.

The other important constraints encountered by the farmers were lack of extension literature on bio fertilizers usage, lack of finance, non-availability of biofertilizer etc.

5.1.6 Suggestions by the farmers for adoption of bio fertilizer

Majority of the respondents expressed that bio fertilizer usage can be increased if they are provided free of cost was the major suggestion offered by the farmers to adopt bio fertilizer technology. The other suggestions were availability of bio fertilizers in villages (76.66per cent), subsidy for bio fertilizers (71.66per cent).

5.2 Conclusions

Following conclusions were drawn from the present study.

5.2.1 Characteristics of respondents

Most of the respondents were from middle age group, had education up to secondary school level and belonged to medium size of land holding.

Majority of biofertilizer users (39.16 per cent) had high level Of cosmopoliteness , 45.00 per cent had medium social participation. Most of the respondents (40.00 per cent) had high level scientific orientation, in case of mass media utilization 51.66 per cent respondents had medium level of mass media use.

5.2.2 Knowledge and adoption

As regards levels of knowledge and adoption the respondents were under medium category in knowledge and low level of adoption of biofertilizer use.

5.2.3 Relationship of selected independent variables of respondents with their knowledge and adoption

Independent variables like education, social participation, extension contact, scientific orientation, cosmopolitaness and mass media utilization of respondents were found to be positively significantly related with knowledge and adoption levels of the farmers.

5.3 Implications

1. The findings of the study indicates that majority of respondents (77.50 per cent) faced constraint of inability to understand the details of biofertilizer so it is implicated that training programmes have to be organized exclusively on biofertilizer use in different crops for farmers.
2. The present study also reveals that about (67.50) respondents faced problem of non availability of biofertilizer locally at times when needed so that it implicated that timely and local availability of biofertilizers at the village level would enable the farmers in adopting biofertilizer technology
3. It is also seen from present study that (41.66 per cent) of respondents faced the problem of non availability of extension literature on biofertilizer usage so it is implicated that folders, leaflets, posters, on biofertilizer technology should be published

and its coverage through radio, television and news paper is needed to educate farmers and other concerned.

4. The present study also shows that 54.16 per cent of the farmers had lack of knowledge about practices so it is implicated that At least, a minimum number of demonstrations and field days around demonstrations are to be organized taluka wise to convince farmers on the usefulness of biofertilizer technology.

5.4 Suggestions for future research

1. An exclusive study on constraints in the adoption of biofertilizers may be attempted.
2. A detailed study on efficiency of various information sources in disseminating biofertilizer technology could be taken up.
3. A separate study on training needs of farmers on biofertilizer technology may be undertaken.
4. A comparative study on the knowledge and extent of adoption of biofertilizer by small and big farmers may be taken up.

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Interview schedule

Research Student :

Chavan V.S.
Dept. of Extension Education
Redg.No. R / 013 / 110

Research Guide :

Dr. G.K.Sasane
Professor,
Dept. of.Extn. Education &
Incharge of communication,
M.P.K.V. Rahuri.

**Research Title : Extent of knowledge and adoption of biofertilizers
use by the farmers.**

General information :

1. Name of the farmer :

2. Email/mobile no :

3. Age : yrs.

4. Address :

Village.....Taluka.....District.....

5. Education : std.

6. Occupation :

7. Land Holding :

Type	Area (ha.)
1. Dry land	
2 .Irrigated	
3. Fallow	

8. Cosmopoliteness :

Please indicate the frequency of visits to the nearby town/city for each of the following purpose.

Purpose of Visit	Frequency of visit		
	Always	Seldom	Never
All visits relating to agriculture			
Some visits relating to agriculture			
Personal/Domestic			
Entertainment			
Other			
No response			

9. Social participation:

Please tell which of the following places you have participated and what extent ?

Sr. No.	Organization	Type of participation		
		Office bearer	Member	No participation
1.	Co-operative Society			
2.	Gram panchayat			
3.	Taluka Panchayat			
4.	Zilla parishad			
5.	Dairy Society			
6.	Self Help Group			
7.	Shetkari Vigyan Mandal			
8.	Others(Bhajani mandal, Mahila mandal etc)			

10. Extension contact :

Please tell which of the following persons / places you have visited and how frequently?

Sr. No	Extension Workers	Frequency Of contact		
		Always	Sometimes	Never
1	Agriculture Assistant			
2	Assistant Agriculture Office			
3	Assistant Horticulture Officer			
4	Agril. University Scientists			
5	Krishi vigyan Kendra (SMS)			
6	Input Dealers			
7	Extension Personnel of Private Companies			
8	Others (if any), specify			

11. Scientific orientation :

Please state your agreement or disagreement with the following statement

Sr. No	Statements	SA	A	UD	DA	SDA
1	New methods of farming give better results to a farmer than the old methods					
2	For getting information about improved technologies farmers should visit agril. Universities.					
3	Even a farmer with lot of experience should use new methods of farming					
4	A good farmer experiments with new ideas in farming					
5	Traditional Method of Farming have to be changed in order to raise the level of living					
6	For enhancing living standard farmers should give up traditional methods of farming					

12. Mass media utilization:

Please indicate the extent of utilization of Mass Media.

Items	Extent of Utilization		
	Regularly	Occasionally	Never
A)Print Media			
1.News papers			
2.Magazines			
3.University publication			
B)Electronic Media			
1.Radio			
2.T.V.			
3.Mobile			
4.Internet			

13. Knowledge of farmers about specific aspects of biofertilizers

Sr. No.	Specific knowledge about biofertilizer usage		Knowledge level	
			YES	NO
1	Type of the biofertilizer used	Rhizobium <i>Azospirillum</i> PSB Azatobactor Others		
2	Source of availability	Agricultural University Fertilizer shop Others		
3	Method of application	Seed treatment Seedling dipping Broadcasting Split application		
4	Quantity required for one hectare	1 kg 10 kg 500 gm		
5	Time of application	Before sowing After sowing		
6	Time gap with in which the treated seeds to be sown			
7	Using biofertilizer without mixing with chemical fertilizer			
8	Using biofertilizer before expiry date			
9	Nutrient supplied by the biofertilizers	Nitrogen Phosphorus Both		
10	Quantity available in packets	250 gm 500 gm 1 kg		
11	Cost of biofertilizers	Rs. 50/kg Rs. 70/kg Rs. 50/kg		
12	Advantage of biofertilizers usage			

14. Adoption of specific biofertilizer practices by farmers

Sr. No.	Adoption of specific practices of biofertilizers usage		Adoption level	
			YES	NO
1	Type of biofertilizer used	Rhizobium Azospirillum PSB Azotobactor Others		
2	Quantity of biofertilizers used for one hectare	200-400 gm 1 kg 25 kg		
3	Time of application	Before sowing After sowing		
4	Using biofertilizer without mixing with chemical fertilizers			
5	Using biofertilizers before expiry date			
6	Method of application	Seed treatment Seedling dipping Broadcasting split application		
7	Percent of yield increased by using biofertilizer	10 % 15 %		

15. Constrains faced by the farmers in adoption of biofertilizers

Sr. No.	Constraints	yes	No
1	Lack of reinforcement efforts from the department		
2	Inability to understand the details of biofertilizers		
3	Lack of finance		
4	Non availability of biofertilizer locally at times when needed		
5	Lack of knowledge about practices		
6	Non-availability of extension literature on biofertilizer usage		
7	Improper soil condition		
8	Low shelf life of biofertilizer		

16. Suggestions given by farmers:

Sr. No	Suggestions	yes	No
1.	Bio fertilizers usage can be increased if they are provided free of cost		
2.	Availability of bio fertilizers in villages		
3.	Subsidy on bio fertilizers		
4.	Technical aspects on biofertilizer should be provided by extension agencies		
5.	Awareness campaign on popularization of biofertilizers		

8. VITA

Mr. Chavan Vishal Shivajirao

A candidate for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

Title of Thesis : Extent of knowledge and adoption
of biofertilizers use by the
farmers

Major field : Agricultural Extension

Biographical Information

➤ **Personal** : Born on 15nd March, 1991.
Son of Shri. Shivaji Gopalrao
Chavan and Sau. Anusayabai
Shivajirao Chavan.

➤ **Educational** : Passed S.S.C. Examination
(2007) in First class with (80.76
per cent) and Passed H.S.C.
Examination in year (2009) with
First class (70.26 per cent) from
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